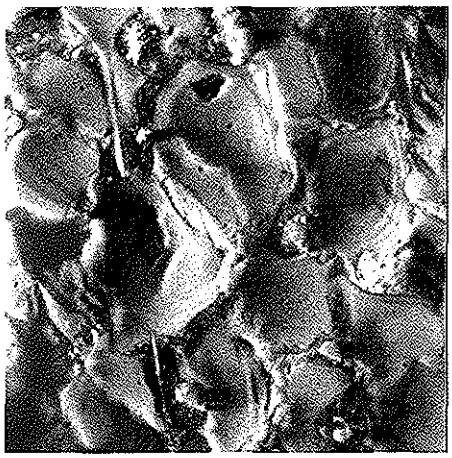

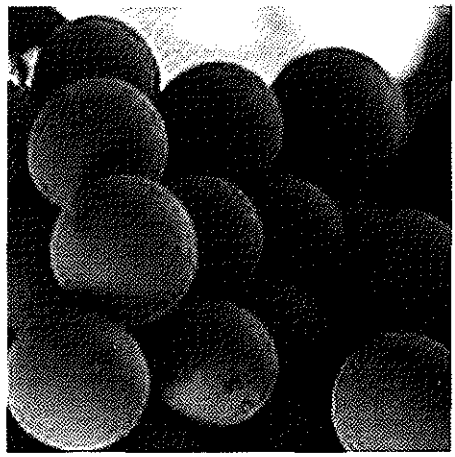

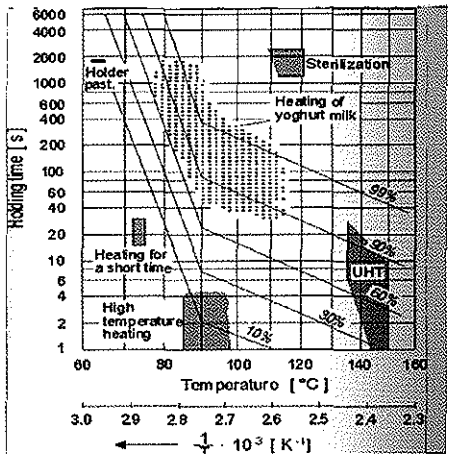

TENTH INTERNATIONAL CONGRESS ON ENGINEERING AND FOOD

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Viña del Mar - Chile
April 20 - 24, 2008

PROGRAM BOOK AND ABSTRACTS

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The study of drying kinetics of red alga *Gracilaria* engages a great technological interest, since this product is worldwide used in the development of agar-agar for chemical and food industry. The aim of this research was to study the sorption isotherms of red alga *Gracilaria* at three temperatures (5, 20 and 40 °C), in addition to study and to model the drying kinetics at four temperatures (40, 50, 60 and 70 °C). In the study sorption, the method used was recommended by the *European Project COST 90*. Modelling of sorption isotherms were carried out following the GAB, BET, Caurie, Halsey and Oswin equations. All the equations showed generally a good fit; however, the Halsey equation was considered the best to predict the experimental data. The monolayer moisture contents were obtained between 0.05-0.08 g water/g d.m. The sorption heat was calculated using the Clausius-Clapeyron equation giving 15.90 $kJ \cdot mol^{-1}$ at a moisture content of 0.07 g water/g d.m.The drying experiment was carried out using a convective dryer. The drying air velocity was held constant at 2.0±0.2 $m \cdot s^{-1}$. All the drying unit operations were carried out in triplicate. The samples (100.0±1.0 g) are placed as a *thin-layer* in a stainless steel basket. This mass was measured on an analytical balance at time intervals defined, connected by a system interface to a PC, which recorded and stored the data. The diffusivity coefficient increased with the temperature from 2.76 to 22.41 $x10^{-9}$ $m^2 \cdot s^{-1}$, with an estimated activation energy of 39.92 $kJ \cdot mol^{-1}$. Four mathematical models were applied on drying experimental data, however the Modified Page model obtained the best fits for each drying curve based on the statistical tests employed (r^2, *SSE*, *RMSE* and ^{2}). In consequence, both models are excellent tools for estimating the drying time of this product. At last, the main utility of this study to the engineering food field, is the appliance of different statistical and mathematical tools in this unit operation, which can be considered a basis for a very accurate estimation of drying time and optimize the same process.

Q21
INACTIVATION BEHAVIOUR OF YEASTS DURING DRYING

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Various food microorganisms play important role not only in food processing but also as food itself. Among them yeasts have been extensively used for making breads, beers and other foods or beverages. However, the inactivation mechanism of yeasts during and after drying is very complicated and still not known fully. In this study inactivation behaviour of bread yeasts during hot air drying was investigated. Effects of sugars on both thermal and dehydration inactivation were also examined.
Thermal stability of bread yeasts in water (suspension) was first investigated with and without protective agents (sugars). All yeasts showed a sharp decrease of the fermentation activities above 318K after one hour. Sugars such as trehalose and sorbitol stabilized the yeasts when the sugar concentration was ca 40wt%.
The drying curves of yeasts at 303K showed a typical constant drying rate period, where water in the interstitial space of pressed yeasts evaporates. Then, the falling rate period was observed, where water inside the cell starts diffusing out through the cell membrane. The activity (fermentation power) during drying at 303K decreased in this period. The yeast in water (suspension) is stable at 303K for a few hours. So this decrease of activity from 30 to 60 minutes (average water content <0.1-0.2) is due to dehydration inactivation.
When the relative remaining activity was plotted against the average water content, it was clearly shown that the activity decreases when the average water content is below 0.1-0.2 (dehydration inactivation). Adding sorbitol before drying (3wt%) improved the stability during drying. Other drying conditions such as the relative humidity and the sample thickness were also examined. Rapid drying conditions resulted in lower remaining activities at the end of the drying.

Q22
OSMOTIC TREATMENT COMBINED WITH MEAT FERMENTATION: EFFECT OF WATER LOSS ON FERMENTATION KINETICS

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Traditional processes of meat fermentation involve sequential operations of salting, fermentation and drying. An alternative process for the fermentation of non-comminuted meat consists of two successive operations : a first osmotic treatment to partially dehydrate and to impregnate the meat with salt and sugars, followed by a fermentation with added starter culture. This innovative sequential operations combination is proposed in an attempt to shorten and simplify the process and to minimise sanitary risks associated with the fermentation step, especially under tropical conditions. In what extent meat can be subjected to a pre drying step before fermentation? To answer this question, we evaluated the effect of water loss during the osmotic treatment on the kinetics of fermentation. Beef meat fillets were immersed in solutions with concentrated solutions of salt and glucose syrup. Salt concentration of the soaking solution and immersion time were designed in order to obtain water loss from 20 to 30, salt and sugar gain of 2 g/100g initial mass (usual meat products salt and sugar contents). Then they were inoculated with *Lactobacillus sakei* and incubated at 25°C and 98% relative humidity. At known incubation time intervals, meat samples were assayed for their microbiological load, pH, glucose, lactic and acetic acid contents. Kinetics of fermentation showed that for both conditions, lactic acid bacteria growth was accompanied by a decrease of the pH, glucose and L-lactic acid contents, and an increase in acetic acid content within 72 hours of incubation. D-lactic acid was produced within 24 hours after which this amount decreased. These results indicated that lactic acid fermentation occurred in both cases. There was a significant effect of the water loss on the D-lactic acid content produced within 24 hours. D-lactic acid content was 0.6% dry basis and 0.2% for an osmotic treatment allowing a water loss of 20% and 30% respectively. Moreover, glucose consumption was more rapid in the second case, suggesting that both sugar formulation and water loss must be studied in order to identify the best formulation by osmotic treatment that allow optimal fermentation. This innovative process could be an alternative to traditional preservation meat processes.

Q23
ISOTHERMS AND DRYING KINETICS OF OSMOTICALLY DEHYDRATED APPLES (*Golden delicious*)

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The each year larger apples national production, as well as, the higher demand of the food industry for such pre-treated dried fruits, have conducted researchers to better investigate this field. Osmotic dehydration is a partial dehydration through an osmosis process which involves immersing fruits for a given period of time in an hypertonic solution, here a sugar solution. Sugar impregnation allows an inhibition of polyphenoloxydase and prevents the loss of volatile compounds during the dehydration process. It is also used as a pre-treatment process to improve the sensory quality of dried products. This work is divided in two main parts: the experimental determination of the desorption isotherms of fresh and osmotically treated apples at different sugar concentrations and the study of air drying temperatures on their drying kinetics.
A static gravimetric method, based on the use of 9 saturated salt solutions was used to determine the sorption isotherms of fresh apple